

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

PEL0016 ELECTRICITY AND MAGNETISM

(Foundation Engineering)

17 OCTOBER 2018
9:00 A.M. - 11:00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

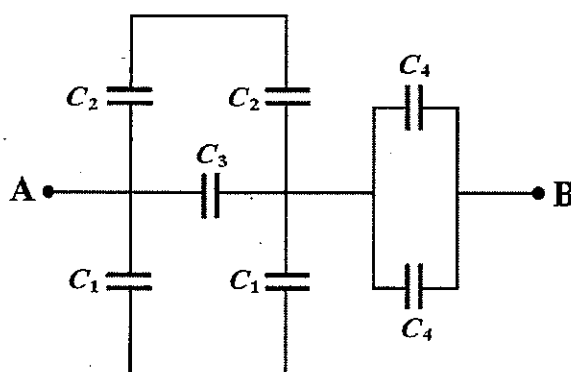
1. This question paper consists of 5 pages including cover page with SIX questions.
2. Attempt **ALL** questions and the distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1

- (a) Three charges, $Q_1 = 2 \mu\text{C}$, $Q_2 = -1 \mu\text{C}$ and $Q_3 = -1 \mu\text{C}$, are located respectively at $(0, 0)$, $(30 \text{ cm}, 0)$ and $(0, 40 \text{ cm})$. A test charge, $Q_4 = 4 \mu\text{C}$, is placed at $(30 \text{ cm}, 40 \text{ cm})$:
- (i) Calculate the magnitude of the net force acting on the test charge Q_4 .
[9 marks]
 - (ii) Determine the direction of the net force acting on the test charge Q_4 .
[3 marks]
- (b) Two 10 nC charges are located at $x = -4 \text{ cm}$ and $x = 4 \text{ cm}$.
- (i) Calculate the electric potential at point P, $x = 0$.
[6 marks]
 - (ii) Calculate the work required to bring a 20 nC charge to point P.
[2 marks]

Question 2

- (a) The electric field between the plates of an oil-filled capacitor is $5 \times 10^3 \text{ V/m}$. The plates are separated by 4 mm apart, the dielectric constant of the oil is 5 and the charge on each plate is $1 \mu\text{C}$.
- (i) Determine the capacitance of the capacitor.
[4 marks]
 - (ii) Determine the area of the plate of the capacitor.
[3 marks]
 - (iii) Determine the energy stored in the capacitor.
[3 marks]
- (b) Determine the total capacitance of the capacitors between points A and B as shown in the Fig. Q2 if $C_1 = 1 \text{ nF}$, $C_2 = 2 \text{ nF}$, $C_3 = 5 \text{ nF}$ and $C_4 = 10 \text{ nF}$.
[10 marks]

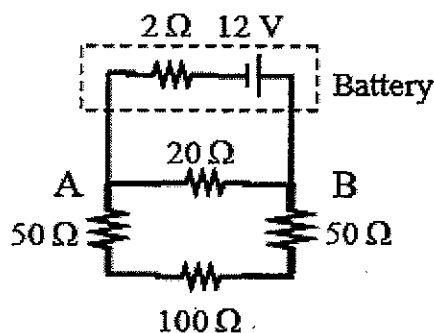
**Fig. Q2****Continued.....**

Question 3

- (a) Two long parallel current carrying wires are placed 2 cm apart.
- (i) Sketch the magnetic field pattern due to the two long parallel wires when they are carrying same amount of current and flowing upward. [2 marks]
- (ii) What will happen to the magnetic field at the midpoint between the two wires? [2 marks]
- (iii) Determine the magnetic field density at the midpoint between the two wires when the left wire carries $I_1 = 5$ A and the right wire carries $I_2 = 1$ A. [5 marks]
- (b) The value of a magnetic field, which is perpendicular to a 10 cm diameter circular wire loop, is changed from 5 T to 0 T in 100 ms.
- (i) Calculate the rate of change of magnetic flux through the wire loop. [4 marks]
- (ii) Calculate the value of the induced electromotive force (e.m.f.). [2 marks]

Question 4

- (a) A 2 mm diameter aluminium wire carries a current of 3 A.
- (i) Find the current density passing through the aluminium wire. [3 marks]
- (ii) What will happen to the current density when the diameter of the aluminium wire is reduced to half the original size? [2 marks]
- (b) A 12 V battery with an internal resistance of $2\ \Omega$ is connected across point A and B of a resistor network as shown in the Fig. Q4.

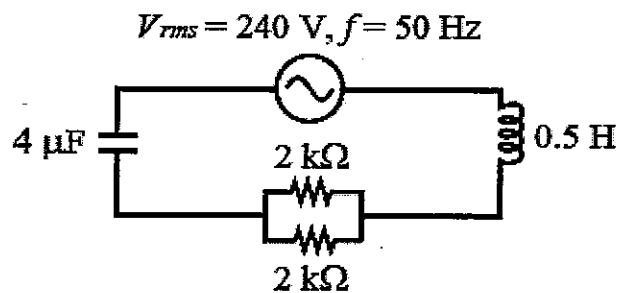
**Fig. Q4.****Continued.....**

Calculate:-

- (i) The current drawn from the battery. [4 marks]
- (ii) The power loss in the battery due to the internal resistance. [2 marks]
- (iii) The Thevenin equivalent voltage across point A and B. [4 marks]

Question 5

A circuit consists of two $2\text{ k}\Omega$ resistors, a 0.5 H inductor, a $4\text{ }\mu\text{F}$ capacitor and an alternating (a.c.) voltage source that has r.m.s. voltage of 240 V at 50 Hz is shown in the Fig. Q5.



- (a) Calculate the total impedance of the circuit. [6 marks]
- (b) Calculate the r.m.s. current flowing in the circuit. [2 marks]
- (c) Will the **total impedance** and **r.m.s. current** of the circuit increases or decreases when the voltage source frequency is increased to 2 kHz . [7 marks]

Question 6

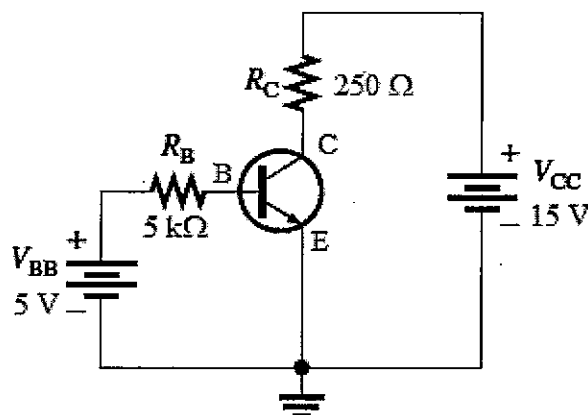
- (a) What is *p*-type semiconductor material? [3 marks]
- (b) Name **TWO** examples of dopants for making *p*-type silicon material. [2 marks]

Continued.....

- (c) **Figure Q6** shows a silicon bipolar-junction transistor (BJT) operating in the common-emitter configuration. The voltage at the base with respect to the emitter is $V_{BE} = 0.7$ V. Other circuit parameters are tabulated in **Table 6**.

Table 6

Parameter	Value
Voltage between collector-emitter loop, V_{CC}	15 V
Voltage between base-emitter loop, V_{BB}	5 V
Collector resistor, R_C	$250\ \Omega$
Base resistor, R_B	$5\ \text{k}\Omega$

**Figure Q6**

If the direct current gain of the transistor is $\beta_{DC} = 10$, solve for,

- The base current, I_B . [2 marks]
- The collector current, I_C . [2 marks]
- The emitter current, I_E . [2 marks]
- The voltage at collector respect to emitter, V_{CE} . [2 marks]
- The voltage at collector respect to base, V_{CB} . [2 marks]

List of constant:-

Electronic charge, $e = 1.602 \times 10^{-19}$ C

Permittivity vacuum, $\epsilon_0 = 8.854 \times 10^{-12}$ Fm⁻¹

Permeability of vacuum, $\mu_0 = 4\pi \times 10^{-7}$ Hm⁻¹

Coulomb's constant, $k = 8.99 \times 10^9$ Nm²C⁻²

End of Paper